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THE MIAMI CONSERVANCY BULLETIN

SEPTEMBER 1920

FIG. 184—MONITOR TEARING DOWN LOCKINGTON PIT FACE. AUG. 5, 1920. SEE PAGE 20

FIG. 185—SLUICING LOOSE GRAVEL AT LOCKINGTON. AUGUST 5, 1920

This shows the short length of channel pipe receiving the discharge of the main pipe, and directing it against the base of the loose pile of gravel. The manner in which the material on the slope breaks off and comes sliding down shows plainly. See Fig. 186.

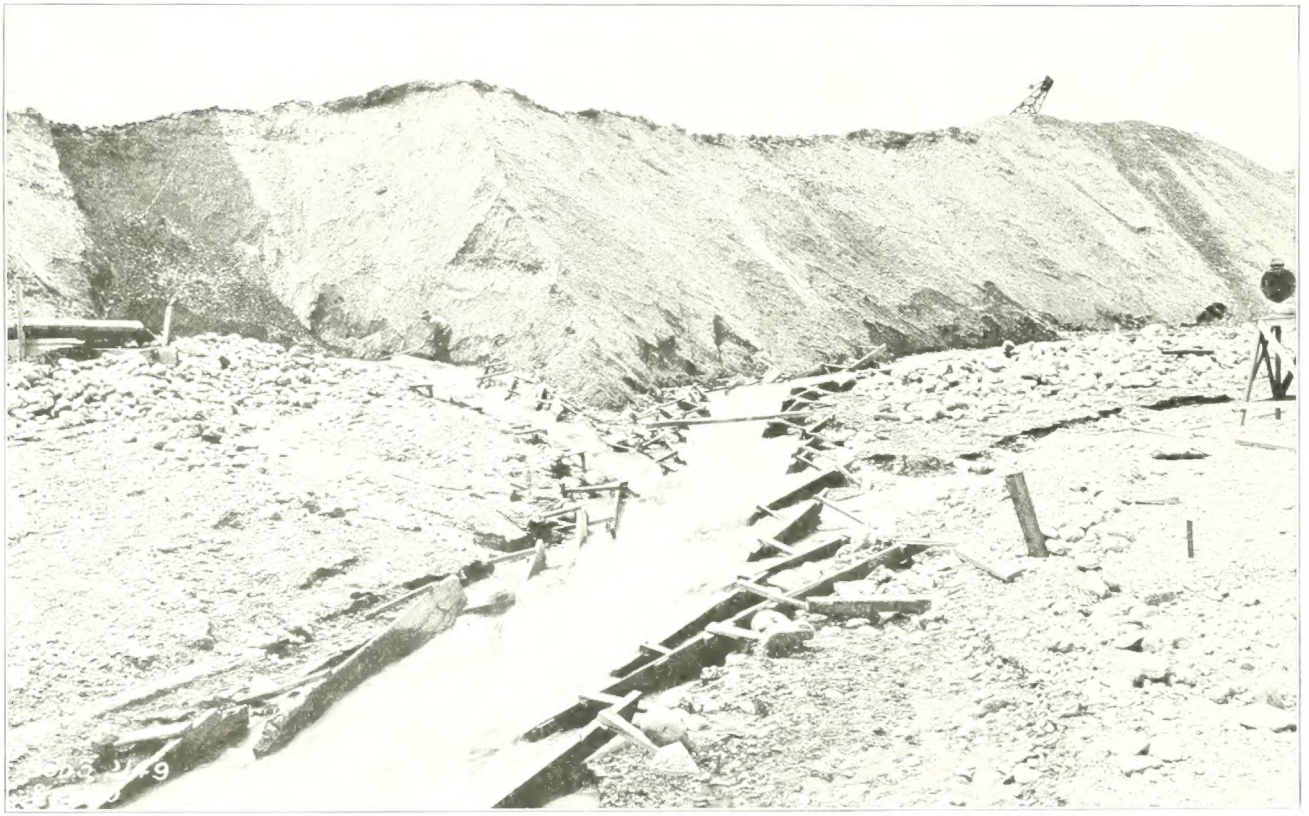

FIG. 186—GRAVEL PILE BEING SLUICED DOWN BY LOW PRESSURE WATER, AND ALSO BY A SLUICE DITCH. AUGUST 5, 1920

This is the gravel pile referred to in the caption to Fig. 185. The pipe at the left is the outlet of a low pressure pipe line carrying 8 cubic feet of water per second, the water being driven by a centrifugal pump in the pump house at the right of the dredge pump house in Fig. 188. The discharge is received in a short length of channel pipe which is manipulated so as to undermine the material at the base of the loose gravel pile to best advantage, this material being then washed into the sluice ditch at the left, by which it is brought to the main sluice ditch in the foreground. This main sluice ditch is directed by "sluice boards" (see Fig. 187), so that it also undermines the base of the gravel pile, as shown farther up the pit in the picture. This sluice ditch is thus bringing down material to the sump from three different sources—from the low pressure pipe line outlet (circulating water, see page 29) from the sluice ditch excavation of the gravel pile, and from the monitor working on the pit from at the head of the sluice ditch. The top of the boom of the dragline which does the original excavating of the gravel, is seen above the gravel pile.

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Subscription to the Bulletin is 50 cents per year. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton, Ohio.

G. L. Teeple, Assistant Engineer, Editor.

Hydraulic Work at Lockington

The present issue of the Bulletin is given over in large part to a description and discussion of hydraulic excavation and transportation of the earth materials in the borrow pit of the Lockington dam. Two articles are presented, the first being of a less technical character, dealing in the main with the underlying principles of the various operations, and the second giving engineering details whose chief appeal will be to members of the profession. Special attention is being given to the articles in the Bulletin on the subject of hydraulic fill dam construction. The literature on the subject seems to be scanty. The method is one which has grown up in accordance with the exigencies of practical construction, with such variations and expedients as were found of value in adapting it to varying conditions. Much of this material has apparently not found its way into print, or is widely scattered through the files of engineering periodicals, and it has never been brought together. It is the hope of those in charge that the matter in the Bulletin, while fulfilling its function as a periodical report to the public of the progress of the Conservancy work, may be a means of collecting and getting together such information on this subject as may bring it up to date; and also, while doing that, to state and illustrate the underlying principles in a manner which may make the Bulletin discussions fill a gap which up to the present appears to be unoccupied.

The work this season, at Lockington, it may be said, marks a decided advance in efficiency over that of last year, as a reading of the articles will indicate, this advance being the result of much study of the details of last year's operation. The improvement made in the work on the dam embankment itself is reserved for a future article.

Big Four Railway Now Open to Traffic on the New Line.

The first train over the relocated line of the Big Four Railway went through on September 3, thus marking another step in the completion of the Conservancy project. It will be remembered that the relocation was made necessary by the interference of the old lines, both of the Big Four and of the Erie Railway, with the construction of the Huffman dam. The two railways are to operate the relocation in conjunction as a double track road between Dayton and Enon, the total distance between the two places being 21 miles. The Erie will begin operation on the new line about October 1. The town of Osborne, a little northeast of Dayton, which later must be abandoned entirely, owing to its being within the flood limits of the Huffman Basin, will continue to be served for the present by both roads, the local trains on the Big Four still running through Osborne instead of running on the relocation, which is some distance on one side.

The total length of the relocated line is 15.2 miles. It is built with a 60 foot road bed, to accommodate eventually four tracks. Its chief feature is the ex-

ceedingly heavy cut at the east end of the Huffman dam, 120 feet in height and comprising over 600,000 cubic yards of material, over 500,000 of which was rock. This heavy work was made necessary by the fact that the ruling gradient on these railways was very flat. It being impossible to change the track levels in the Dayton yard, where the new line started, and the valley slope rising abruptly where the new line swung aside to clear the east end of the dam, this gradient cut heavily into the hillside, as the figures indicate. This gradient begins at Findlay Street, in Dayton, and will necessitate raising the railway yard a little for some distance north of this point, this work being now in progress.

The work has been done by the Walsh Construction Co., of Davenport, Iowa. The grading began about April 1, 1918, and was finished in November, 1919, the operations of track laying, ballasting, etc., having consumed the interval since that date. The total amount of material excavated has been 1,416,000 cubic yards. The same company did the tracklaying and ballasting, subletting the former to Roberts Bros., of Chicago. The gravel for the ballast was obtained in the valley floor borrow pit just above the Huffman dam. The work of supplying it has been done by the District forces, and has occupied more than half the time of the excavating equipment at this pit, delaying thus, unavoidably, the dam construction.

Two new interlocking towers, equipped with 44 levers each, of the electro-mechanical type, have been erected on the new line. One is of brick, located at Tate's Point, in the environs of Dayton, at the crossing with the Baltimore & Ohio R. R. The other is of wood on a steel under frame. It is located at Fairfield, at the crossover between the eastbound and westbound tracks. A passing track and sidetracks at Fairfield are to be completed at a later date.

Stability of Hydraulic Fill Dams

Attention is called to the double page picture on pages 24 and 25 in this issue of the Bulletin, because it presents visibly to the eye a sense of the stability of a hydraulic fill earth dam, properly designed and constructed, as it exists during its most unstable stage—that of construction. It is then, if ever, that a hydraulic fill dam will give way. The picture of the river section of the Englewood dam in its present condition, above referred to, shows clearly how little fear need be entertained on this head as regards the Conservancy dams. The great breadth of the sand and gravel slopes and beaches, enclosing the core pool, as compared with the narrow width of the latter, gives an unmistakable indication of the impossibility that the core material, deposited in the bottom of the pool as it is, should even in its earliest stage of plasticity, before the process of consolidation has become complete, ever be able to break through the enclosing masses of sand and gravel, and thus compel a reconstruction of the dam. In the case of the Conservancy dams such an occurrence is made doubly improbable, by the fact that water cannot remain behind the dam more than a few days, and that only at long intervals, when floods occur. This for the reason that the outlets through the dam embankment are never closed, and the retarding basins behind them drain immediately. The water is not retained long enough to permit any softening effect on the embankment material sufficient to endanger its stability. After the flood, there is a rapid drying out of the embankment, due to the high porosity of the slope material, with a corresponding return to maximum stability.

It may be noted, with relation to the above mentioned picture, that the river section of the dam at Englewood is now up to a level which, with the present temporary spillway in operation, (just beyond the cross dam in the distance, as seen in the picture) makes the embankment safe against a flood equal to that of 1913. Thus another mark has been passed on the road to complete flood protection for the Miami Valley.

The Work in Dayton

The back cover page of the Bulletin is devoted this month to illustrations which were unavoidably crowded over from our last issue. The big dragline excavator in Fig. 196 has now been floated under the bridge where the picture shows it at work, and is engaged in channel excavation several hundred yards downstream. The work on the levee wall just above Main Street bridge is at present the most prominent piece of construction under way in the Dayton river improvement. This wall is of the same type as that just completed between Third and Fifth Street bridges, construction details of which were given in the Bulletin for last March. There are details, however, in which it shows interesting differences. It is hoped to present these in the next Bulletin.

The Lockington Borrow Pit. (See Page 29.)

The dredge pump house is seen at the right. The monitor pipe line is seen crossing the pit just below the pit face in the distance. The two main sluice ditches are seen running from the pit face to the dredge pump house. The pipe line at the left is the low pressure circulating water referred to in the article, page 27, as the second circulating system. (See also page 22). The dragline excavator at the left digs a gravel deposit in the west part of the borrow pit, and piles the material in the heap seen, to be washed down into the sluice ditch by the low pressure water just referred to. The roof of the pump house for this low pressure water is seen over the bushes at the left of the dredge pump house. The dragline excavation is more expensive than that by monitor, but is necessary here because the pit as a whole has a deficiency of gravel, which is supplied by digging deeper into the gravel deposit, this extra depth carrying the pit floor to an elevation below that permitting direct washing by monitor into a sluice ditch. Hence the piling into a heap at higher elevation. The stiffleg derrick at the right of the dredge pump house is used to handle repair parts of the pumps, etc., into and out of the pump house, which has a removable roof to permit this. This derrick, equipped as a dragline excavator, also excavated the original hole for the sump and pump house.

Records Again Broken

Records both at Englewood and Taylorsville have again been broken. At Taylorsville the July run of concrete in the outlet works was 8,087 cubic yards. At Englewood it is the month's record for material pumped into the dam embankment—18,552 cars.

Hydraulic Excavation and Transportation of Borrow Pit Materials

Principles Underlying These Processes as Developed in the Work at the Lockington Dam.

In last month's Bulletin the hillside borrow pit at Huffman was described, with the arrangement by which the pit face is broken down by the hydraulic monitor and the material sluiced from the pit through a pipe flume directly to the top of the dam embankment, without other pumping than that necessary to supply the monitor. At Lockington the valley slope is so flat, and the elevation of the upper hillside so little above the top of the dam, that this process is not economical. Some material could be sluiced to the dam by the method, but in amount so small that the cost of erection of the necessary plant would more than counterbalance the advantage. At Lockington, therefore, the material, after being broken down from the pit face by hydraulic monitor as at Huffman, is sluiced to a sump on the lower valley slope, adjacent to the dam, and pumped thence to the embankment by dredge pumps. (See Figs. 184 and 188.)

The general process is to tear down the pit face by the monitor jet, and to "sluice" the eroded material to the dredge pumps by means of water rushing down the slope of the pit bottom in a "sluice ditch." The sluice water is supplied partly by the spent monitor jet, and partly from a ditch system on the valley slope above the pit face, directed over the tops of the pit bank, this ditch system being supplied from a reservoir or forebay, fed by a culvert pipe from the Miami and Erie Canal. (See Fig. 191). At the lowest point in the borrow pit the sluice ditch empties into a "sump," whence the water and earth are lifted by the dredge pumps and driven to the top of the dam embankment. The general arrangement is simple, but its efficient carrying out at Lockington involves several interesting details.

A hydraulic monitor works most efficiently (see Fig. 184), when placed as close as possible to the pit face which it is excavating, because the closer it is, the solider the issuing water jet will be, and the higher the velocity with which it strikes the material. Also, for maximum efficiency the jet must be directed against the base of the pit face, since then it works by undercutting. The bank, thus undermined, comes tumbling down from time to time in great masses, which, broken and crumbled by the fall, are then easily knocked to pieces by the jet and the loose earth washed into the sluice ditch and on to the pumps. As the bank breaks off, the face of it recedes continually from the monitor, till it gets so far away that the jet no longer does efficient work, on account of being more or less whipped into spray before it strikes. The monitor line must then be extended and the monitor reset once more close to the pit face.

With these conditions it is evident that the deeper the pit the more earth can be excavated at one setting of the monitor, and the less labor will be used in moving forward.

There are several limitations to the depth, however. One is evidently the occurrence of bed rock, or of clay or other strata too tough to be efficiently excavated by the jet.

Another is the matter of efficient dredge pumping. The deeper the pit bottom, the deeper the dredge pumps must be set, since the pit bottom must slope toward the pumps in order that the materials may be carried to the latter. But the deeper the dredge pump setting, the higher the materials must be pumped to drive them to the top of the dam where they are deposited. A point is reached where the gain in height of pit face is counterbalanced by the added cost of pumping.

Still another limit, at Lockington, was set to the pit depth by the necessity of guarding the pumps from flood in seasons of high water in Loramie

By means of the "sluice boards" set up diagonalwise to the flow of the ditch water on one side, the flow in the ditch is directed against the base of the low hill of pit floor material shown, thus undermining it, and bringing down the excavated earth to the dredge pumps. The action is precisely analogous to that seen in a river which undermines its bank on the outside of the bend where it swings round a curve. Thousands of cubic yards of material have been undermined and brought down to the pumps at Lockington in this manner.

FIG. 187—SLUICE DITCH UNDERMINING AND EXCAVATING THE BORROW PIT FLOOR. JUNE, 1920

Creek. At Lockington thas was the determining factor. The pumps were set at the lowest safe elevation (895 feet above sea level, the dam crest, when finished, being at elevation 954, and the valley floor at 885). To get the sump level as far below the pumps as possible, thus lowering the borrow pit floor (since the sump water and pit floor at the sump are at practically the same level), the pump suction pipes were made as long as possible. From this lowest possible level at the pumps, the pit floor slopes gently upward in all directions at a sufficient angle to bring the excavated material down the sluice ditches to the pumps.

The degree of the slope of the pit bottom is important, because it determines the amount of material which with a given area of borrow pit can be brought down to the pumps. The flatter this slope —that is, the flatter the rise of the pit floor—the higher will be the face of the pit bank at any given distance from the pumps; and the higher the pit face, the greater the amount of material excavated. At Lockington last season, the gradient of the slope varied from about 4 to about 5½ per cent (depending upon the pit floor materials). This season, by proper manipulation, the slopes have been flattened so that they vary from about 2½ to about 4 per cent, a reduction of about 1½ per cent. The increase in the quantity of materials thus made available within the present limits of the borrow pit cannot be exactly estimated, but it is between 200,000 and 300,000 cubic yards.

This flattening of the pit floor slope was accomplished by increasing the amount of water running in the sluice ditches. The water comes down these ditches at high speed. Like all swiftly moving stream water, it tends to erode its bed. But also it comes down the slope heavily loaded with material washed down from the pit face by the hydraulic monitor, varying in coarseness from fine clay to stones a foot or more in diameter. (See Fig. 193). The flowing stream tends to drop the coarsest of these materials and thus fill up its bed. If it flows at sufficient speed, it erodes its bed faster than it drops the coarser materials, and the stream slope flattens. But the flattened stream slope slows down the water's speed, and the slackened speed causes it to erode its bed less, and drop more coarse materials. Thus in time the slope arrives at a stage of equilibrium, when the ditch bed erosion is just balanced by the dropped material.

Increasing the quantity of water flowing in the ditch disturbs this equilibrium, by increasing the speed of the water, the increase being due to the fact that a smaller proportion of the water is now in contact with the rough ditch bed which impedes it. (The lower layers of water "grease" the ditch bed for the upper layers to slide over, and when the quantity of water is increased there is a greater thickness of these upper layers). The increased speed will increase the erosion, and this in turn will flatten the ditch bed slope. Conversely, diminishing the quantity of water will steepen the ditch slope. The increase in the quantity of water, just discussed, has the advantage not only of flattening the ditch slope, but of carrying a greater quantity of eroded material to the pumps by reason of the increased volume of flow.

It may also be noted that in passing over a portion of the pit bottom containing a greater proportion of coarse materials, the ditch slope will steepen, since these coarse materials will impede the flow, thus requiring a steepened slope to produce the speed of equilibrium at which, carrying a given material, the deposition and erosion balance. Conversely, when flowing over fine materials, the ditch slope flattens.

The velocity of the water is increased and the ditch slope flattened not only by increasing the quantity, but by concentrating the flow. It is clear that a broad shallow stream will be much more impeded by its rough bottom than the same stream when made narrower and deeper. At Lockington this concentration is produced by means of "sluice boards," like those shown in Fig. 186. These form artificial wooden banks, between which the water is penned to a swift arrowy stream.

The Lockington sluice ditches are set to work eroding pit material as well as carrying it to the dredge pumps. It is well known (see Bulletin for May, 1919), that the chief erosive power of a stream is exerted upon the caving bank at the outside of a curve, where the river swings round a bend. At these points the bank is undercut (just as the hydraulic monitor undercuts the pit bank), and falls in masses into the stream, to be carried away by the current. This effect is made use of at Lockington to excavate the bottom of the borrow pit. By taking away the sluice boards from one side of the ditch, and pushing those on the other side farther into the stream, the current is deflected against the exposed side, undercutting it, and carrying the material away to the pumps. By continuing the process the ditch is gradually bent aside to a totally new course, mowing away the intervening pit floor as it shifts. Fig. 187 shows this process in full swing. At Lockington the undercut ditch bank has been sometimes as much as ten or fifteen feet in height, the ditch thus performing a considerable work in excavation which otherwise would devolve upon the monitor.

Another application of this process is seen in Fig. 186, which shows a bank of loose earth thrown up by a dragline excavator, against the base of which one of the sluice ditches is directed by means of the sluice boards. Such loose material is undermined with great rapidity. It is dug by the dragline from depths in the pit too low to permit direct sluicing to the pumps. Therefore the material has to be thrown first to higher elevation. Dragline excavation is more expensive than that by hydraulic monitor, but was necessary in this case because of the insufficiency of gravel in the pit as a whole to furnish the necessary thickness of porous embankment in the dam in proportion to the impervious core. The gravel in the borrow pit occurs mostly in the west part of it, and to obtain it in sufficient amount a greater depth had to be excavated.

Another method of removing the loose bank of gravel excavated by this dragline is shown in Fig. 185, where one side of the bank is being eaten away by a stream of water issuing from a fifteen-inch pipe, and washed down into one of the sluice ditches. This water is pumped at low pressure by a special pump.

The water in the sluice ditches at Lockington has a velocity of about nine feet per second. At this speed it is able to transport stones to the pumps, by rolling them along the ditch bottom, larger than can go through the pumps. A "grizzly," or grating, of iron bars spaced about six inches apart, is placed at the mouth of the ditch, where it debouches into the sump, to catch the "oversize" stones, two or three men, removing them as fast as they accumulate. At most of the dams it will be remembered, this work of separation is done by a revolving grizzly, made of a long cylindrical steel shell, rotated by an electric motor, and perforated with seven-inch holes. The earth and smaller stones drop through these holes into the sump below, while the oversize stones roll on endwise through the shell (which is set on a slant), and drop into a dump car. Such a grizzly could have been used at Lockington, but would not have permitted the excavation of the borrow pit to quite so low a level (since the levels of the pumps and sump are fixed by considerations of safety against floods, as explained above, and the grizzly must be set a certain working distance above the sump water level to operate properly). Also, since the grizzly requires one or two attendants in any case, its expense of construction and operation would make the total cost of operating it at Lockington somewhat greater than that of simple grating such as is used.

The proportion of oversize stones in the Lockington borrow pit is low, averaging about 1½ per cent. Where these stones occur thickly, as in the gravel strata in the west part of the pit, the problem of getting them out of the way of the monitor jet is somewhat vexatious. They soon cover the pit floor, at the base of the bank which is being jetted down, to a depth such that they act like "riprap" on a river bank, protecting the earth beneath from the impact of the jet, and seriously impeding the progress of the excavation. An expedient sometimes used in such a case is to bury the stones by boring a hole beneath them with the jet, into which they gradually sink out of sight. The process is entirely feasible, but rather expensive in time and power consumed, and when done, is only a postponement of the day of reckoning. The buried bones are sure to rise again at a later stage in the pit excavation, to stare the operator in the face and demand a further disposal.

The reason for this is that the part of the pit floor near the working face of the bank does not come at once to the flat final slope given it by the sluice ditches, because the latter, at this point, are

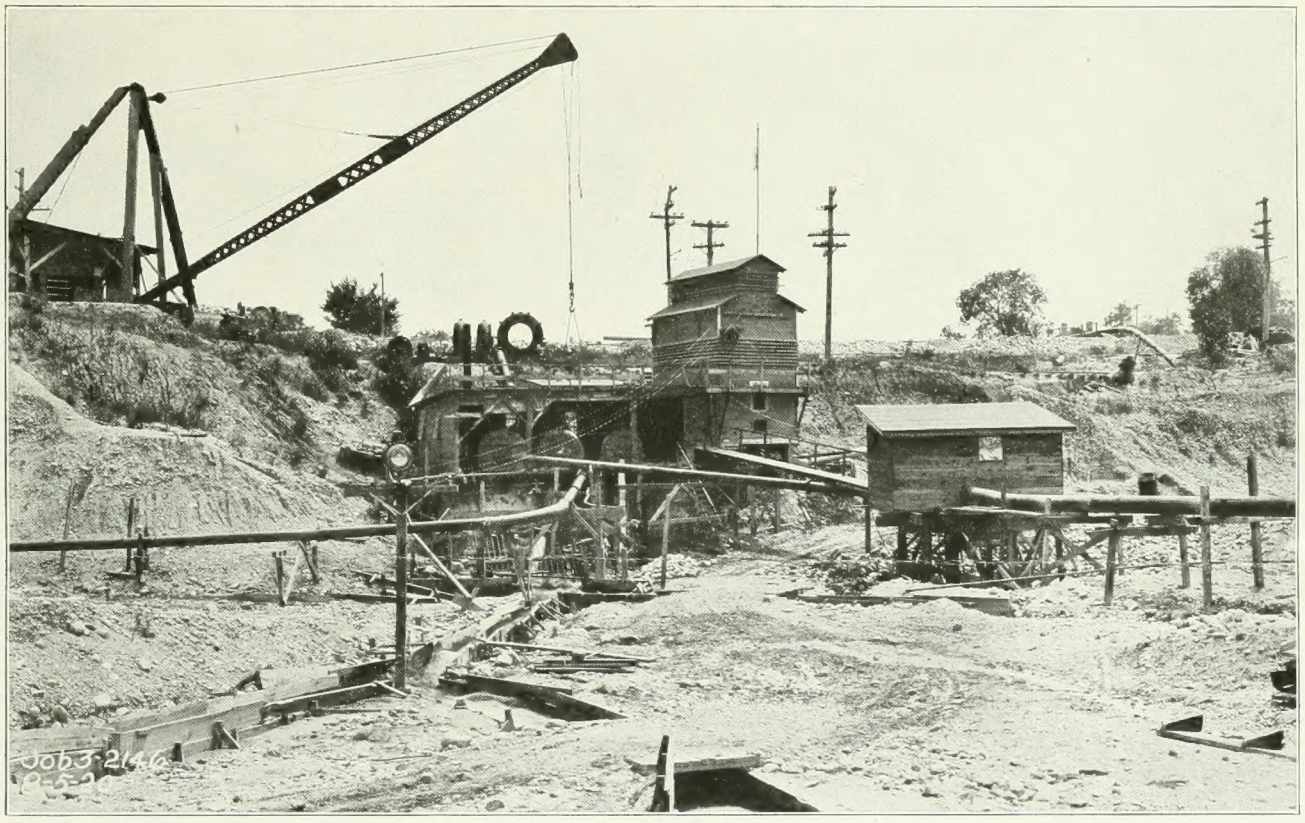


FIG. 188—PUMP HOUSES AT LOCKINGTON. AUGUST 5, 1920

The middle structure is the dredge pump house; that at the right is the house for the low pressure pump used to drive the water in the second circulating system described on page 29. The auxiliary sump there described, supplying water to the two circulation systems, is under this house. The pipe at the right is the low pressure discharge; at the left is the discharge of the first circulating system, running to the gravity ditch above the borrow pit face. The long pipe at the center, running from the left-hand pump in the dredge pump house, is the suction of this pump, which actuates the first circulating system. (See page 28). The stiff leg derrick at the left handles the machinery parts when changes must be made in the dredge pumps, etc. The junction of the two main sluice ditches coming down to the dredge pumps from the borrow pit, is seen at the left in the foreground. The dredge pipe line to the dam embankment is seen climbing the slope at the right.

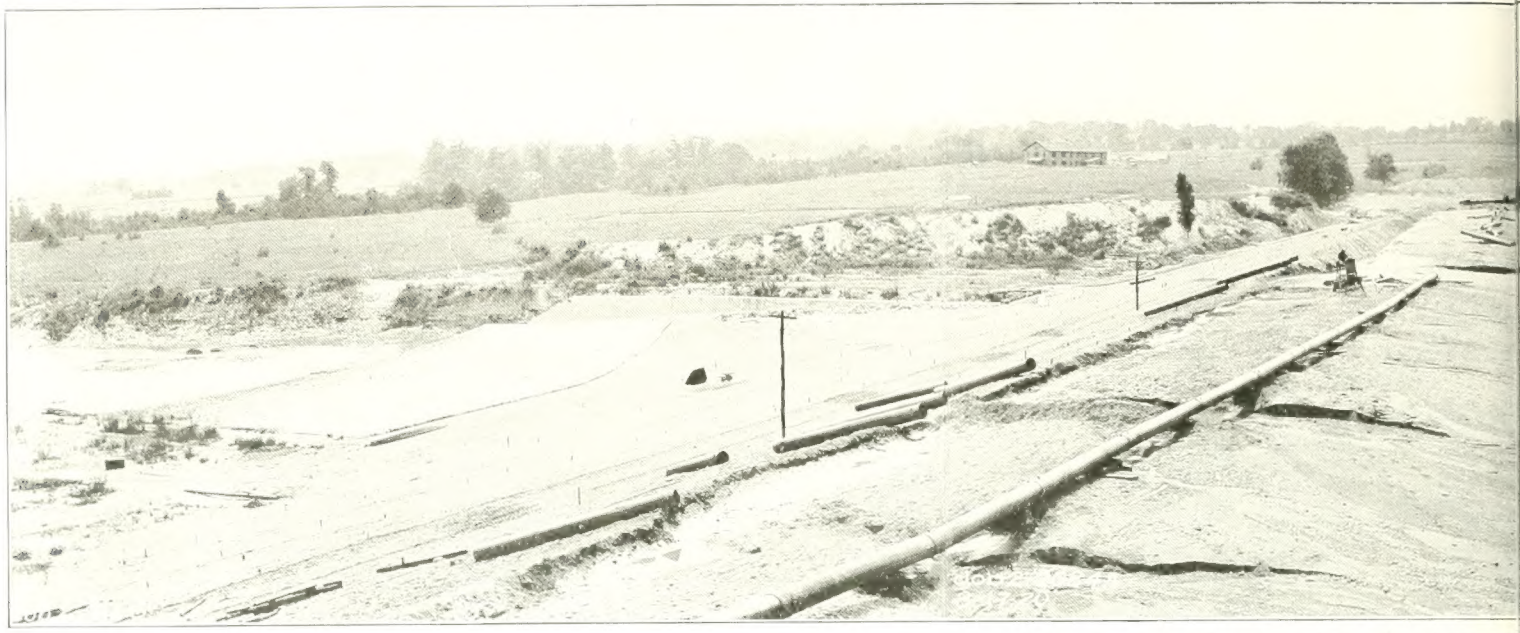


FIG. 189—RIVER SECTION OF THE EN

The view is northwestward, endwise of the dam. The work in the middle foreground occupies the old bed of the Stillwater River, which is now running through the conduits. The walls of the conduit outlet are seen at the left, with the river beyond. The river above the conduit inlet can be seen at the extreme right, but the walls of the inlet structure are hidden by the levee topping the upstream slope of the rising dam embankment. The dragline excavator seen in the distance stands on a cross dam which it keeps building higher to retain the core pool seen in the right foreground. This dam is located on what was the old right bank of the river. The slope in the foreground, at the extreme right, is the slope of the cross dam similarly built on the old left bank, the pool being retained between these two cross dams and the upstream and downstream levees of the rising dam embankment. The gravel slopes and beaches, enclosing the core pool, show clearly the nature of dam structure, the dam core being built up by mud deposited from the water of the pool, and the material for both the core and the gravel slopes being pumped to the dam top through the pipe lines seen along the levees. The pump house in the foreground is mounted on a scow, which rises as the pool rises, the pump taking water from the top foot or so of the pool and returning it to the dredge pumps for a fresh load of embankment material. The timber tower is built on the

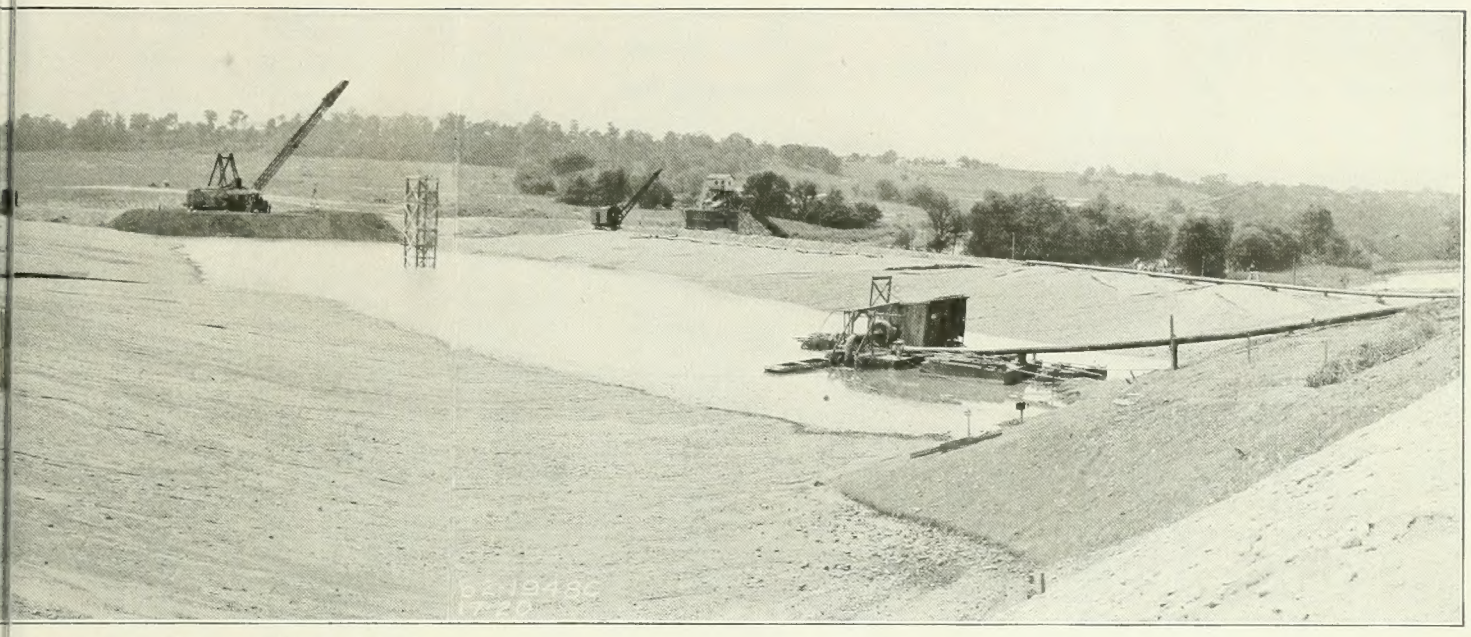
not fully formed. These ditches are given their swiftest, and most concentrated flow by the sluice boards, and the sluice boards do not get into effective operation until the ditch gets some distance downstream from the pit face. Near the pit face the sluice water, derived from the monitor jet after the latter has been dissipated by striking the face is of the bank, and from the ditch water cascading down the pit face (see Fig. 184), is more or less scattered and ineffective for erosive purposes, and therefore leaves the pit floor near the base of the bank lying at a steeper angle. It is on this steeper slope that the stones are buried. Later, when the pit face has been pushed back by the advancing monitors, this steeper grade is mowed down by the sluice water, now gathered into one swift and powerful stream by the sluice boards. (See Fig. 184). The buried stones are thus again undermined and brought to the surface, to block the sluice ditch until they are removed. For these reasons burial by means of the jet is inadvisable.

At Lockington, the practical solution of this problem is to load the oversize stone into a wagon, as soon as they gather on the pit floor thick enough to impede the monitor jet, and cart them to the dam embankment to be used as paving for the slopes. This paving, built in part also of stones carried to the beach slopes of the core pool through the dredge pipes, will give the final finish to the embankment surface, in place of the grass slopes originally planned. The finished appearance can be seen in the downstream slope of the dam, shown in Fig. 180 in the last Bulletin.

The size of the stones brought down by the sluice ditches is always a source of surprise to those who see it for the first time. The largest brought down at Lockington are shown in the picture, Fig. 193. The heaviest weighed 376½ pounds, the other two being 275 and 205 respectively. Rock of such dimensions are not rolled continuously down a ditch bottom. They are shifted a little at a time, as the water gets a favorable "hold."

The work on the dam embankment at Lockington has only been touched upon in this article. It will be treated at length in a future issue of the Bulletin.

FIG. 190—CREST WALL TOPPING THE DAYTON LEVEE. JULY 24, 1920 (See Page 31)



LEWOOD DAM. AUGUST 17, 1920

ter line of the dam to support pressure cells which are imbedded in the core material below. These indicate the horizontal and ral pressures in the core, giving thus a measure of the consolidation of the core material. (See Bulletin for April, 1920.)

The most significant feature of the view is the demonstration it presents, directly to the eye, of the stability of the hydraulic fill construction. Note the narrow width of the pool, which deposits the core material, as compared with sand and gravel slope and beach enclosing it at the left, remembering that a similar slope and beach encloses it on the right, though not so clearly seen. These slopes and aches are of clean, solid sand and gravel, which drain perfectly to permit the escape of the entrained water of the core material, permitting the latter to consolidate as time goes on. With such broad, stable masses of sand and gravel enclosing the core the practical possibility of the core material ever breaking through and flowing out into the valley above and below, as some have feared, is clear the eye. It is worth pointing out that such an accident would occur during dam construction, if at all, since it is at that time that core material is most unstable. The picture shows why the Conservancy engineers have no worries concerning such an occurrence the Conservancy dams.

August Progress on the Work

GERMANTOWN

During the month of July 62,670 cubic yards of hydraulic embankment was pumped into place on the dam, bringing the total embankment at the end of July up to 669,700 cubic yards. This yardage makes the dam 84.7 per cent completed.

The large dragline is now preparing to cross over the old borrow pit and excavate enough material from the island formed between the creek and the borrow pit to finish the dam.

At the present writing the pumping plant is shut down, due to this program for the dragline. Advantage is being taken of the shut down to repair pumps and locomotives, to patch the floor in the hog box and to make minor repairs on the little dragline.

During the month work has been started on the drainage system for the dam. The gutters along the edge of the dam are being laid up with dry rip-rap. Good progress is being made on this work.

This month also marks the starting of work on the spillway bridge excavation. Three piers are being put down into rock. The excavation of the spillway is rapidly nearing completion. It will probably be finished by the latter part of August.

The facing of the upstream slope of the dam with dry rip-rap is continuing daily. The earth surface dressing on the downstream slope has been completed to elevation 780. Gravel is being placed on that portion of Road No. 1 from the camp to the top of the dam.

J. C. McCann is making excellent progress on Road No. 2. He expects to finish before the last of August, after which he will move his equipment to the dam, using it to spread material from the spoil banks along the outlet works, over the old creek bed, and to backfill against the concrete retaining walls of the outlet works.

Arthur L. Pauls, Division Engineer.

August 16, 1920.

ENGLEWOOD

Hydraulic fill has progressed favorably during the month. The dredge pumps handled 153,380 cubic yards, and 5,450 cubic yards were placed in the rolled embankment in Cross Dam No. 2. The total yardage to date, including all classes of embankment, is 1,600,000 or 46 per cent of the estimated quantity. The best month's record for hydraulic fill has again been broken, 18,552 cars being pumped.

The hydraulic fill in the river closure has reached an elevation of 825, a height of 57 feet above the river bed. Within a week a sufficient height will have been reached to insure safety against overtopping in case of a repetition of the 1913 flood, with the temporary spillway and enlarged conduit in service.

Cross dam No. 2, west of the river, has reached a height of 830, or 20 feet below its projected elevation. This should be completed during the coming month.

Oversize rock, rejected from the dredge pumps, has been placed on the upstream slope of the dam in the river closure. Rubble paving around the outlet conduit has been continued.

New tracks in the borrow pit have been laid and ballasted.

H. S. R. McCurdy, Division Engineer.

August 21, 1920.

LOCKINGTON

During the past month 2,770 cubic yards of material has been the daily average placed in the dam by the hydraulic fill method. The average height of the embankment west of the outlet structure is 37 feet below the finished top of the dam, and on the east side 39 feet below.

The stone surface dressing is advancing at a rate to keep it even with the earth fill and indications are that it will prove to be a very desirable finish for the dam. The stone is a by-product of the hydraulic fill operations.

Some minor repairs have been made on roads 9 and 10, and arrangements are nearing completion for resuming work to finish Road 9.

Barton M. Jones, Division Engineer.

August 20, 1920.

TAYLORSVILLE

The total quantity of concrete placed during July was 8,087 cubic yards. This is our best record for one month. The yardage for August will not be much above 6,000 cubic yards, as we are finishing on the upper end where the walls are not so thick.

The east wall, the center wall and the floor are finished. The west wall will be finished in two weeks, and by the middle of September the piers under the spillway should be up to the height at which they will be left until the earth dam is completed. This will finish the concrete in the outlet works except the spillway wier, which cannot be placed until the fall of 1921.

The sluicing is making fair progress. The Lidgerwood dragline has been started on the excavation of the inlet channel during both shifts, and casting up the material to where it is sluiced to the dredge pump. The dredge pump handles all this material during the day shift. Also an extra 3-inch nozzle under about 175 pounds pressure has been started, which will add about 1,000 to 1,200 cubic yards to the daily output of the dredge pump.

The grading on Road 12 has been finished from the east end of the dam to the top of the bluff near Station 26.

O. N. Floyd, Division Engineer.

August 23, 1920.

HUFFMAN

The rolled clay blanket has been completed under the upstream half of the dam, and material is now being pumped onto both slopes of the dam embankment, in the section left open during the past season for the flow of the river. 37,000 cubic yards of material were placed in the dam during the month of July. The entire time of the day shift and a part of the night shift have been occupied in getting out ballast gravel for the railroad work.

The small steam dragline is back on the main dam building slope levees. The downstream levee has been built up to elevation 806, from the end dam to the Erie Railroad. The dragline is now crossing to the upstream side and will build the levee on this side up to the same elevation.

The sluicing of material from the hillside at the north end of the dam has been continued very successfully during the past month.

C. C. Chambers, Division Engineer.

August 15, 1920.

DAYTON

Dragline D-16 was moved under the Third Street bridge August 2 and is now excavating between Third Street and Fifth Street, this material being carried to the gravel plant on scows. Dragline D-19, after finishing a channel for the passage of D-16 under the Third Street bridge, has returned to the 20-inch water main above Dayton View bridge and is lowering the last section of that pipe. Dragline D-15 is continuing channel excavation below Washington Street.

South Robert Boulevard river wall is complete, except for backfilling and cleaning the site. Bank Street crest wall has been completed. Good progress is being made with Stillwater Drive wall, where the mixing plant is nearly ready for operation and Finke Engineering Company has nearly completed the preliminary excavation. Some concrete has already been placed. Work on Sunset Avenue retaining wall, extending northerly from Third Street bridge, has been started.

Price Brothers have discontinued revetment work in Dayton for a short time.

To date 33,400 cubic yards have been issued from the gravel plant.

Up to August 1, channel excavation amounted to 919,500 cubic yards. The pay quantity in spoil banks and levees amounted to 588,000 cubic yards. Levee embankment amounted to 75,900 cubic yards, including 60,000 cubic yards on Contract No. 41. The total yardage handled in accomplishing this work was 1,522,000 cubic yards. None of the foregoing figures includes excess excavation for the launching basins and scowing canals, which amounts to 95,000 cubic yards.

C. A. Bock, Division Engineer.

August 23, 1920.

HAMILTON

The electric dragline D-16-18 is loading cars on the west side of the river about midway between the Main Street bridge and the railroad bridge.

Dragline D-16-17 is proceeding with the excavation for Pier No. 4 of the Black Street bridge. Concreting of pier 3 has been completed to about low water level in the river. The cable-way towers have been erected and it is expected that the cable-way will be in operation within a few days. This cable-way is for the purpose of handling materials during the erection of the bridge. The mixing plant is being placed on the east abutment.

Dragline D-16-20 has completed the sewer work on the west side and is now grading for the next track to carry the trains for serving the electric dragline.

Price Bros. have laid 10,000 blocks in the flexible revetment, and 75 slabs of the slope revetment.

Another dragline is being installed for the completion of the Old River channel west of the B. & O. R. R.

Excavation and concreting are being continued on the Black-Clawson wall.

C. H. Eiffert, Division Engineer.

August 20, 1920.

TROY

The cut-off channel has been practically completed by Clapp, Norstrom & Riley, the opening into the old river bed having been made on August 7. All but two hundred and fifty feet of the right side of the main river channel below the B. & O. Railroad bridge has been dug to the required grade, and the levee along the right side is complete except for three hundred feet. Their total pay excavation, made up of Items 6 and 9, amounts to 104,000 cubic yards. The total levee embankment, on this section of the work amounts to 43,000 cubic yards. In making this embankment, about 2,500 cubic yards of material had to be handled twice.

The C. & C. Haulage Co. has excavated from the river channel and placed in embankment 14,000 cubic yards of material, between Market and Adams Streets. This material is practically all "top soil," being taken from a shallow cut, averaging four feet, along the overflow part of the improved channel. Their second shovel and three more Sterling trucks arrived, and were at work on August 3.

The contract for building the levees on the north and south sides of Morgan Ditch, at the north end of Troy, has been let to The Finke Engineering Co. of Dayton. Their equipment, consisting of a Thew steam shovel with a three-fourths yard dipper, and seven teams, has been at work since the last week in July. The total yardage placed in the south levee amounts to 4,000 cubic yards. The levee on the south side of the ditch, is the west end of the levee, extending all through town, on the right side of the river, and will average sixteen feet in height. The levee on the north side will be raised to the height of the present M. & E. Canal embankment, and will protect the farms from flood water up to the protection given now by the canal embankment. The height of this levee will be about ten feet above the natural field level.

R. F. Griffin, Assistant Engineer.

August 15, 1920.

LOWER RIVER WORK

Miamisburg.—The work on the west side of the river in Miamisburg is rapidly nearing completion. In ten days' time the material should all be in place. At present the Sycamore Street crossing of the B. & O. R. R. is closed while the work of grading and gravelling the roads which extend over the levee to the north and west of this crossing is being completed. These roads will be opened within a few days.

Franklin—During the past month Jeffrey, Boorhem & Co. have completed the Lake Ave. approach to the levee and opened it to traffic, and have placed about 7,000 cubic yards of material in the levee between Lake Avenue and Park Avenue. They are using a narrow gauge train outfit,

consisting of one locomotive and from 7 to 9 four-yard dump cars, the cars being loaded by the dragline machine. The average haul for this section is about 900 feet.

Middletown—The material for the levee between Fifth and Sixth Streets is now all in place and the 300 foot gap at Eighth Street has been filled. The work of dressing this levee is progressing rapidly. This completes the southern section of the Middletown levee. Construction of monolithic concrete and flexible concrete block revetment to extend 900 feet southerly from a point 500 feet south of Fifth Street will be carried on as rapidly as possible. Price Bros. Company have the contract for this work and have commenced driving piles for the footing and anchor walls. Cole Bros. are preparing to haul gravel from the river bottom below Sixth Street with the train outfit, to construct a berm along the river toe of the levee on which the flexible block revetment will be laid.

F. G. Blackwell, Assistant Engineer.

August 20, 1920.

RAILWAY RELOCATION

Big Four & Erie—The Big Four ballasting will be completed so that traffic can be diverted upon the new line September 3. A temporary diversion of traffic over the passing track was made at the west end where the new line joins the old line. This is just west of Findlay Street for about 4,000 feet. All the ballast has been delivered on the Erie Railway and this line will be put in operation about the last week in September.

The signal system is all installed at Tates Point and Fairfield, except connecting up the circuits, and this is also nearly completed. The District forces, with Mr. Kramer, Assistant Division Engineer, in charge, have assisted in signal work, ditching, etc.

Ohio Electric Railway—The ballast on the Ohio Electric, west of Fairfield has all been distributed, and as soon as the Walsh Construction Company complete the Big Four and Erie they will dress and finish this line. The District forces have the pole line 70 per cent complete.

Baltimore & Ohio Railroad—The tearing up of the rail in the old line is in progress. The track material has been sold to the B. & O. Railroad.

Albert Larsen, Division Engineer.

August 20, 1920.

RIVER AND WEATHER CONDITIONS

The rainfall in the Miami Valley during the month of July varied from 3.14 inches at the Taylorsville Dam to 5.35 inches at Ingomar, on Twin Creek. At Dayton it was 3.76 inches, 0.48 inches more than normal, reducing the accumulated deficiency since January 1 to 2.43 inches.

A rise of about 8 feet occurred in the Stillwater River during the first part of the month, due to the precipitation of from one and a half to two inches which fell on July 2. Freshets of less importance also occurred in some of the other streams of the valley due to this storm. During the rest of the month the stages were comparatively low.

Observations taken at the local office of the U. S. Weather Bureau show that the mean temperature for the month was 72.2 degrees, or 3.8 degrees less than normal; that there were 17 clear days, 7 partly cloudy days, 7 cloudy days, and 10 days on which the rainfall amounted to or exceeded 0.01 of an inch; that the average wind velocity was 8.4 miles per hour; and that the maximum wind velocity for five minutes was 33 miles per hour from the northeast on the 30th.

Ivan E. Houk, District Forecaster.

August 31, 1920.

Hydraulic Equipment and Operation at the Lockington Dam

Engineering Details Showing the Layout and the Improvements Instituted During the Present Season.

Study and observation on the methods used last season in sluicing material for the Lockington dam embankment, led at the beginning of the present season to several modifications which have been of marked value in increasing the efficiency of the operations.

The present layout at Lockington is shown in plan in Fig. 191. The water consumed in the various operations is obtained from the Miami and Erie Canal, which runs conveniently a few hundred feet east of the east end of the dam. The quantity required is about 20 cubic feet per second during two ten-hour shifts. As the city of Piqua, a few miles below the dam, depends on this canal for its water supply, it was necessary, in order to insure a sufficiency for Conservancy needs, to make extensive repairs to the Sidney feeder, which brings water to the canal from the Miami River at Port Jefferson, and also to the State dam at the latter place. These repairs were accepted by the State as payment for the water to be used. In order to make certain that Piqua should never run short of a full supply, the quantity of water available from these improvements was made considerably greater than the Conservancy requirements.

Of the 20 second feet taken from the canal, one half is pumped through the monitors to tear down the pit face. The other half is led over the top of the pit face, wherever the monitor is working, to increase the flow in the sluice ditches. The total flow is picked up by the dredge pumps at the sump, and sent to the core pool on the top of the dam embankment, whence it overflows through vertical shafts in the back of the outlet walls of the dam structure, into the new channel of Loramie Creek, now flowing between these walls. Two subsidiary circulating systems take water from the dredge pump sump, and return it again after using it for sluicing operations in the borrow pit, as explained later. The entire water system is thus comprised in four parts.

To steady the source of supply, the water is led from the canal, through a pipe culvert controlled by gates, to a small natural reservoir, or forebay, just south of the east end of the dam. The main ditch of the gravity supply takes from this forebay through gates, and is led along the valley slope in a course roughly parallel to the upper edge of the borrow pit and connecting with it by laterals which enable water to be dropped over the bank wherever a monitor may be working. This main ditch has a capacity of about 25 cubic feet per second, made necessary by the fact that besides the flow from the reservoir, it must also carry the discharge from one of the circulating pumps.

The monitor pump house is located at the west end of the forebay, and is equipped with three Allis Chalmers centrifugal pumps, direct-conected to 3-phase, 60 cycle induction motors, taking current from the Dayton Power and Light Co.'s 30,000 volt transmission line, which was extended from Piqua for Conservancy use. All pumps on the work are driven by induction motors from this line.

Two of the monitor pumps are 8-inch centrifugal pumps, driven by 100 horse power motors, and so arranged that they can be connected either in series or in parallel. Each has a capacity of 2,500 gallons per minute against 125 feet head. The third monitor pump is "a booster," a 14-inch pump with a capacity of 5,000 gallons per minute against 115 feet head, or of 2,500 gallons per minute against a 230 foot head. With the two 8-inch pumps working in parallel a

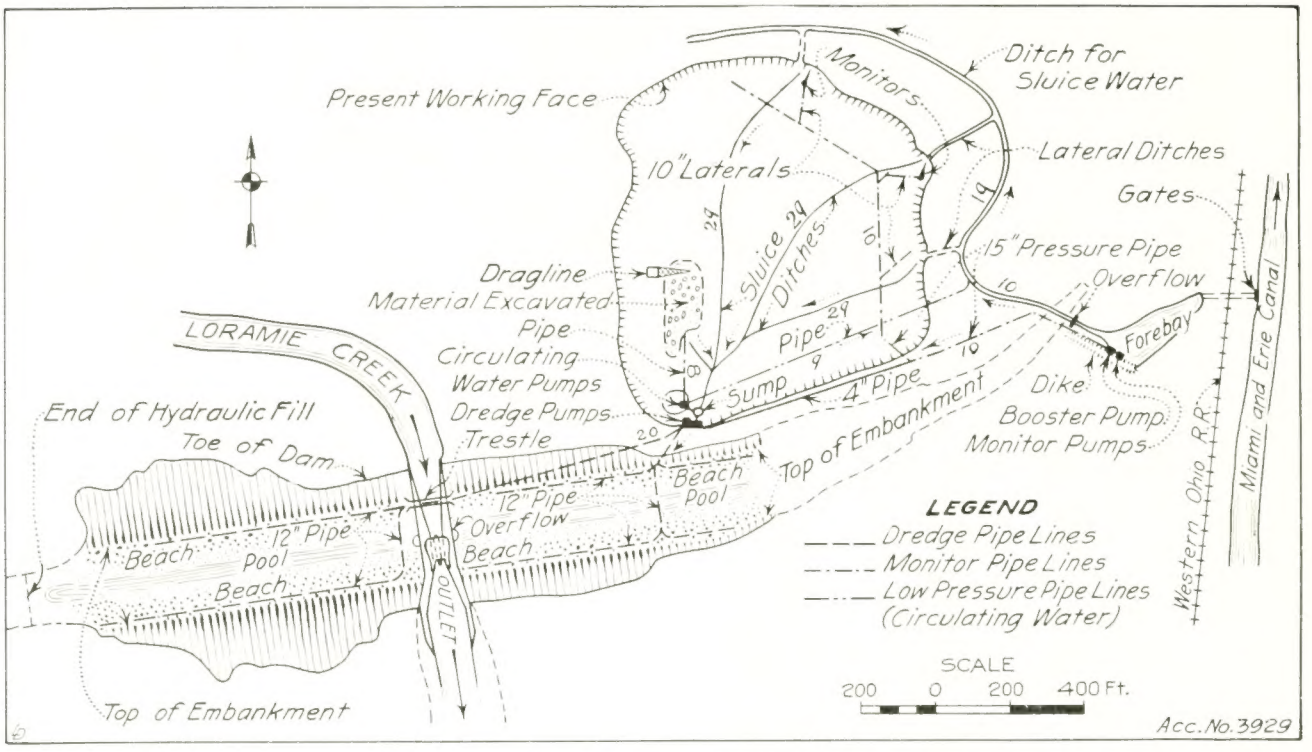


FIG. 191—BORROW PIT AND PUMPING LAYOUT AT LOCKINGTON DAM

The water used comes from the Miami and Erie Canal at the right, the flow in which was enlarged for the purpose. The water flows from the canal to the forebay or reservoir, at which the monitor pumps are located which supply the high pressure water for tearing down the face of the borrow pit, the latter being indicated by the hatched line. The "ditch for sluice water," running parallel to the pit face, draws an additional supply from the forebay by gravity, and pours it over the pit face wherever a monitor is working, to help swell the flow in the sluice ditches leading down the borrow pit from the pit face to the dredge pumps, these sluice ditches carrying the materials excavated by the monitor jet. The dredge pumps take the water and earth material from the sump and drive it through the dredge pipes to the core pool on top of the dam embankment. The overflow from the core pool drains through vertical conduits in the backs of the outlet structure walls of the dam, to the channel of Loramie Creek, now flowing between these walls.

pressure of from 40 to 70 pounds per square inch is obtained at the monitor, depending on whether a 5-inch or a 4-inch nozzle is used. The 5-inch nozzle is used to excavate the pit face where the material is softest. (A loamy gravel). On such material the large jet at low pressure is much more efficient than the same amount of water at higher pressure. For hard clay a 2½-inch jet is used at 175 pounds pressure. To obtain this all three pumps are connected in series. For intermediate materials a 3¾-inch jet is used at about 120 pounds pressure. This is obtained by conecting the two smaller pumps in parallel, and the larger pump in series with the combination. This adaptation of different pressures and nozzles for different refractoriness of the pit materials has proved very advantageous.

The main monitor pipe line runs from these pumps into the pit and along the pit floor roughly parallel with the pit face. It is of 15 inch spiral rivetted steel pipe, 12 and 14 gage. Lateral branches, leading from this main to the monitors, are of 10-inch flanged wrought iron pipe in about 20-foot lengths.* Since two or three monitor settings are often used in a single day, requiring an almost continual shifting or extending of these branches, gate valves are placed at strategic points to enable these shifts to be made at any time. The total length of the monitor supply line varies from about 800 to about 2,000 feet.

The booster pump on the monitor line, described above, was set at work early in June of the present year, as one of the improvements which last season's experience suggested. A second improvement was in taking a large flow of idle ground water, which ran out of the gravel in the west part of the borrow pit into the dredge pump sump, and setting it at work bringing down material. This ground water diluted the loaded flow from the sluice ditches by about six second feet, requiring thus nearly two-thirds of the capacity of one dredge pump just to get rid of it. The idea suggested itself to set up a third pump in the dredge pump house, which should take this idle ground water, and pump it into the gravity ditch above the borrow pit face, thus compelling it, as it came back down the sluice ditch, to bring down a load of material to the sump, and save the dilution and the waste in pumping. This idea was carried out, the added pump being run at a capacity of about nine second feet, this quantity thus circulating continually, being pumped "empty" from the sump to the gravity ditch, and returning loaded, like a conveyor belt or a train of dump cars. In order that this water might be as free from suspended material as possible, the suction of the circulation pump was led to an auxiliary sump, located

*It has been found that longer lengths (of about 30 feet), of light weight pipe would have been more desirable for these branches, on account of the large amount of shifting above noted.

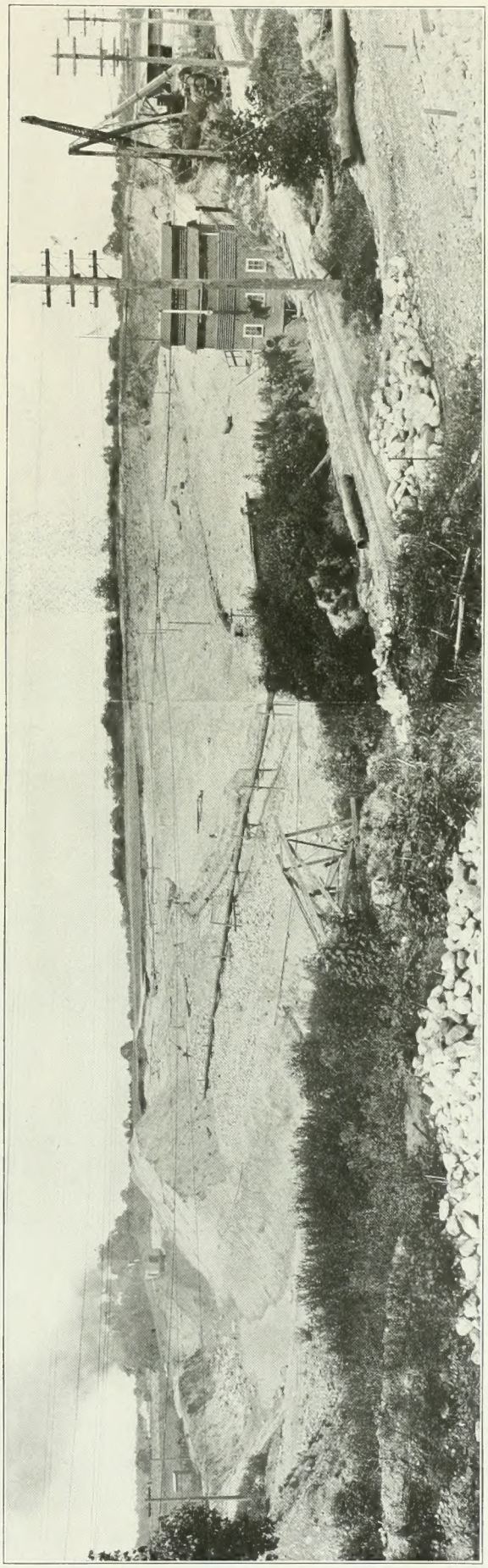


FIG. 192—THE BORROW PIT AT LOCKINGTON. AUGUST 23, 1920. SEE PAGE 20

near the main sump in a location to intercept most of the ground water flow out of the gravel belt, and connecting with the upper level of the main sump by a pipe culvert, the object of the latter being to steady the sump water level. This circulating water evidently makes no difference with the quantity of water in the sump, since whatever is taken out by the pump is immediately returned by the sluice ditch. Neither does it make any difference in the quantity passing through the dredge pumps. Its operation is simply to compel all the water passing through those pumps to take a load of material with it.

The effect of the increase in the sluice ditch flow, thus produced, in flattening the borrow pit slopes, has been noted in the preceding article. This flattening has averaged about 1½ per cent, and has increased the quantity of available material in the borrow pit, over the present area, between 200,000 and 300,000 cubic yards. Besides doing this service, the increased flow in the sluice ditches also decreases the labor necessary to keep these ditches clear.

It was noted in the preceding article that a dragline excavator digs in the gravel bank in the west part of the pit, below the regular pit floor grade, and throws up a bank of loose sand and gravel to a higher level, to be carried to the dredge pump sump by sluice water. This dragline is a Class B Lidgerwood machine with a 75 foot boom and a 1½ yard bucket. The sluice water is supplied by a second circulating system, like the one already described, the quantity being about 8 second feet. It is drawn from the same auxiliary sump that is used for the first system, by a centrifugal pump working at 13 pounds pressure, and is driven through a 15-inch pipe to the point of operation. A short length of channel pipe receives the stream of water as it debouches at the base of the bank, and is shifted by hand to accomplish the washing down of the loose material to the best advantage. By this second circulating system an additional 800 cubic yards of material is fed to the dredge pumps during the day shift, the pump being idle during the night. The dragline excavator, to dig this quantity, has to work during both day and night shifts.

It will be noted that with both dredge pumps running the flow in the sluice ditch is 29 second feet, of which 10 comes from the monitor, 10 from the gravity ditch, and 9 from the circulation system. When the sluice ditch receives also the flow from the second circulation system—that supplied to bring down the loose gravel bank—the flow is increased thereby to 37 second feet, the maximum ditch flow at Lockington. In either case, however, the flow through the dredge pumps is the same—20 second feet, the change being only in the load of material pumped.

It is worth noting also that the water supplied to the gravity ditch by the reservoir, and that supplied to the monitor, is in each case about 10 second feet in amount, and that this is also about the capacity of each dredge pump. This equality in capacity has advantages in operation. Thus if it is necessary to shut down one dredge pump for any reason, it is necessary also to decrease the flow coming down the sluice ditch by the same amount, or the sump will flood. This is conveniently accomplished by

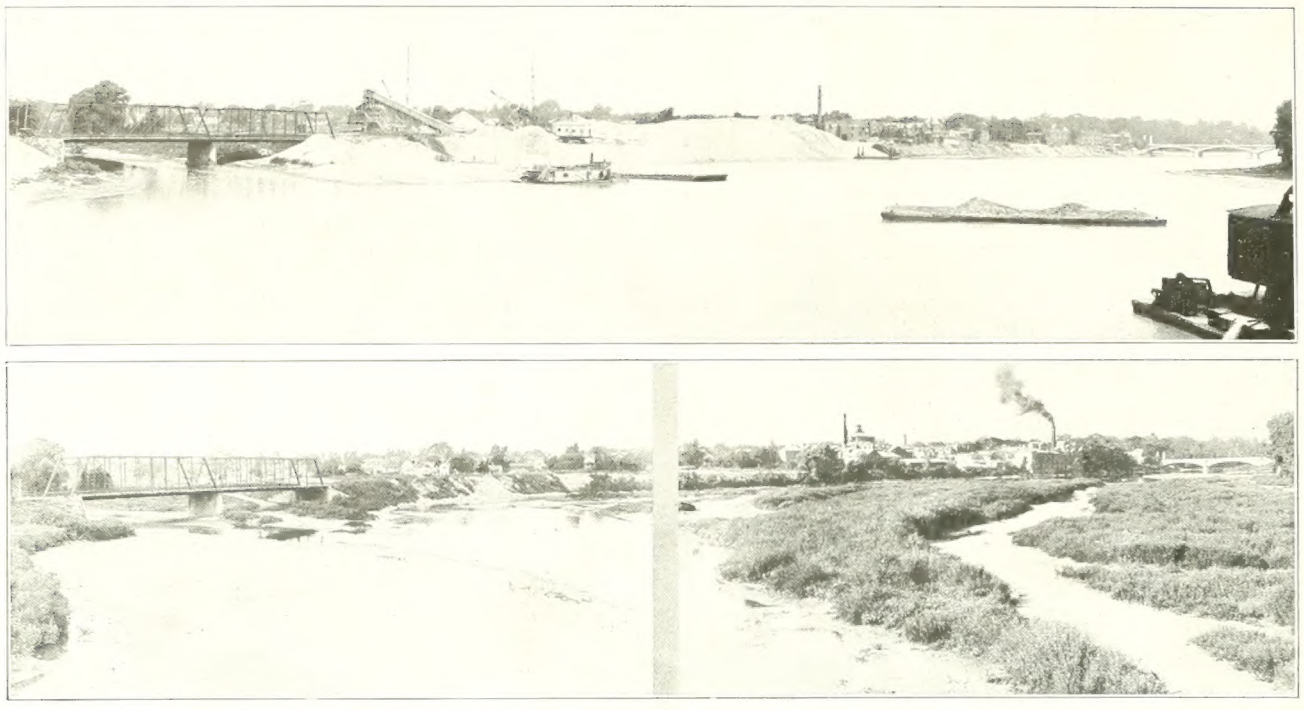


FIG. 195—EFFECT OF CONSERVANCY WORK ON THE MIAMI RIVER

The lower pair of views show the condition of the river, as seen looking upstream from Third Street bridge, September 14, 1917, the two views nearly but not quite matching, as they are taken from slightly different positions. The upper view covers the same ground, in one picture, taken July 24, 1920. The improved river channel, in the upper view, has been practically excavated to grade, and only needs finishing in a few places, which work will be done at a later date. The excavation was done by a Class 175 Bucyrus dragline excavator with 135-foot boom and 3½-yard bucket, mounted part of the time on a scow (the machine on its scow being shown in Fig. 196), and part of the time on trucks. This machine will soon move under Third street bridge for work on the river below. The increase in channel capacity appears plainly in the contrast between the conditions before and after the work. At the left in the upper picture the gravel washing and screening plant appears, with piles of the accumulated material, which is obtained in excellent quality from the regular river excavation. This gravel will be used later in concrete walls, revetments, etc., in connection with the levee improvement. Some of it is sold at market rates, and thus affords the District an income.

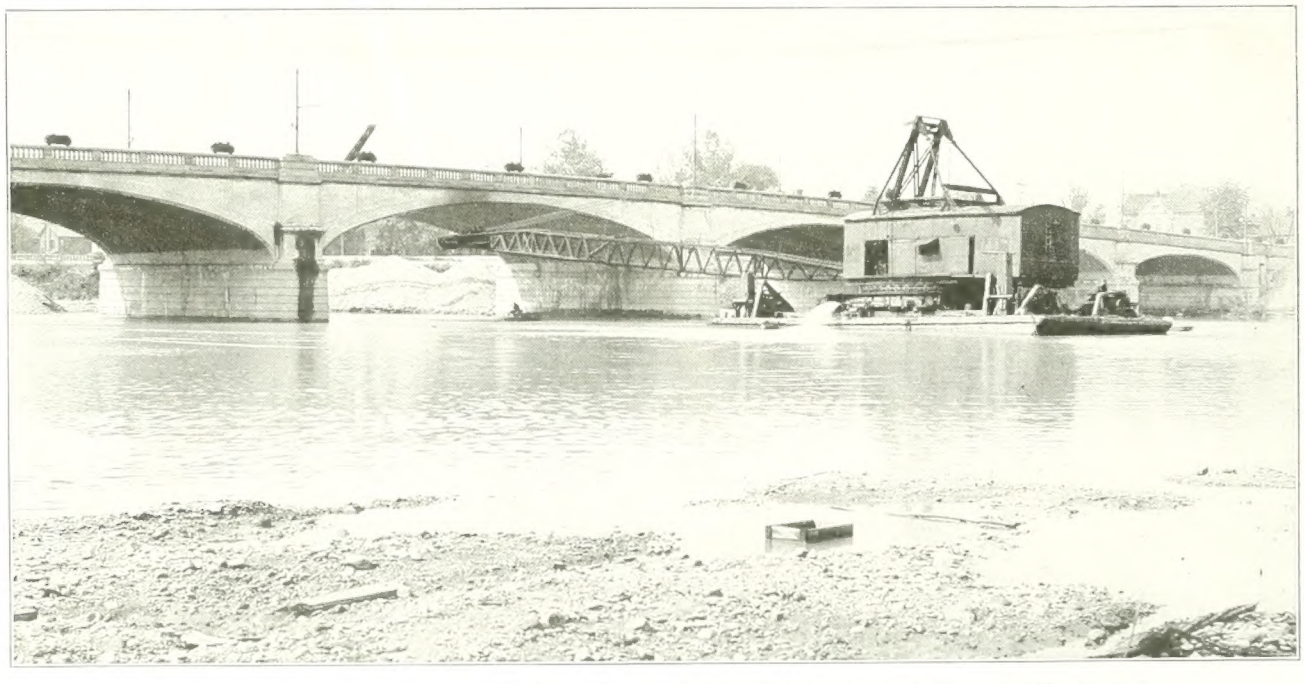


FIG. 196—EXCAVATING UNDER THE THIRD STREET BRIDGE. JULY 23, 1920

The bucket of a dragline excavator ordinarily must be dropped nearly vertically to the river bottom to get its load. Under the bridge this is impossible. Hence the scheme shown, which is to put two draglines at work, one each side of the bridge, playing a game of "see-saw" with two buckets. The two drags, (the boom of the further, projecting above the bridge, is the only part seen of the second,) are placed facing each other. The heels of the two buckets are attached to each other by means of chains or steel cable. The buckets are then hauled back and forth beneath the bridge, by the two loading cables, "clawing" the earth on the bottom out from under the structure and dropping it in the clear where it can be picked up afterwards in the regular manner. The boom of the near dragline is lowered so that it can project under the bridge to facilitate the operation.